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(21) International Application Number: PCT/US91/00162 (22) International Filing Date: 8 January 1991 (08.01.91) (30) Priority data: 410,635 8 January 1990 (08.01.90) US (71) Applicant: PARAGON FILMS INCORPORATED [US/ US]; 3500 West Tacoma, Broken Arrow, OK 74012 (US). (72) Inventor: DOHRER, Gregory, L. ; Paragon Films Incorporated, 3500 West Tacoma, Broken Arrow, OK 74012 (US). (74) Agents: DRY, N., Elton et al. ; Pravel, Gambrell, Hewitt, Kimball & Krieger, 1177 West Loop South, 10th Floor, Houston, TX 77027 (US).		(81) Designated States: AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH (European patent), CM (OAPI patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GA (OAPI patent), GB (European patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL (European patent), NO, PL, RO, SD, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent). Published <i>With international search report.</i>
(54) Title: SINGLE-SIDED CLING STRETCH FILM (57) Abstract <p>This invention relates to a single-sided cling stretch wrap film wherein the A layer exhibits a high cling force. The opposite surface is cling-free and is fabricated from a polyolefin having an MFR less than or equal to 10.0. A particularly preferred film is an A/B/C thermoplastic film of high tensile strength. Pallet loads overwrapped with the film are neither torn or destroyed when separated from each other. The cling-free layer may contain a medium or high density polyethylene. The productivity in the fabrication of the polyolefin film is improved by the use of medium or high density polyethylene.</p>		

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APPLICATION FOR PATENT

TITLE: SINGLE-SIDED CLING STRETCH FILM

SPECIFICATIONField of the Invention

This invention is drawn to a single-sided stretch wrap film containing one surface which exhibits a cling property and an opposite surface which is cling-free. The cling-free layer has a slide property when its surfaces are in contact with relative motion with a cling-free layer of a second like film. The invention in particular is drawn to a high tensile strength A/B/C film structure, wherein the A surface exhibits cling properties, the B layer is primarily responsible for the high tensile strength of the film structure and the C layer is substantially cling free. The cling-free surface of the film of this invention is fabricated from a film forming system containing a polyolefin having a MFR less than 10.0 (ASTM D-1238). The film-forming system of the cling-free surface may further contain a high or medium density polyethylene. The invention is further drawn to a method of improving productivity in the production of a polyolefin selected from polypropylene homopolymers, polyethylene homopolymers and copolymers of ethylene or propylene and an α -olefin.

The addition of a medium or high density polyethylene to the polyolefin increases productivity as much as 60%.

Background of the Invention

- 5 One of the problem areas in the packaging industry concerns the overwrap packaging of goods, particularly the unitization of pallet loads. Ideally, an overwrap material should have high strength, be resistant to tear and puncture, and
- 10 exhibit single-sided cling properties. In particular, single-sided cling properties are required in order to prevent individual pallets from clinging to each other and being torn or destroyed when being separated from each other.
- 15 Development of single-sided cling has, generally, been directed toward surface modifying one side of an A/B film. For example, U.S. Patent No. 4,820,589 discloses an A/B film structure, wherein the A layer has a comparatively high cling
- 20 force to layer B and layer B has substantially less cling force to a layer of itself. The B layer contains nylon. Further, single and two-layer film structures are further disclosed in U.S. Patent Nos. 4,518,654 and 4,833,017, herein incorporated by
- 25 reference. In U.S. Patent No. 4,518,654, the "non-cling" B layer is a polyolefin with an anti-cling additive such as crystalline or amorphous silica, sodium aluminum silicate, diatomaceous earth, and talc. It is not possible to obtain a zero cling
- 30 force for the B layer, however, since the additive

must be present in minimal quantities in order to prevent tearing or fracturing of the film. Further, the coefficient of friction of such films is greater than 2.0 which indicates an unfavorable slideability property of the B layer. Also further, the minimum stretch capability of such films is approximately 50%. Thus, such films neither exhibit a truly cling-free layer or the maximum tensile strength and minimum stretch capability which is commercially demanded.

In order to prevent the tearing or loosening of the wrapping on stacked overwrapped pallet loads, it would be highly desirable to have a tough film exhibiting high tensile strength and greater elongation with good cling properties on one side to engage the contained load and little or no cling properties on the other side to avoid clinging to neighboring stacked, wrapped loads.

Summary of the Invention

The invention comprises novel stretch wrap films and an improved process for preparing such films. In particular, the stretch wrap films of this invention (1) exhibit high tensile strength and an improved minimum stretch capability, (2) are tear and puncture resistant, and (3) have single sided cling. Such films are ideally suited for use in overwrapping of packages and pallet loads. The stretch wrap film of this invention is prepared as a co-extrusion product of the respective layers. One surface of the stretch wrap film of this invention

exhibits cling. The opposite surface, fabricated from a polyolefin having a MFR less than 10.0, is cling-free. The stretch wrap film of this invention includes a thermoplastic A/B/C film structure of differential cling wherein layer A has a high cling
5 force to layer B, layer B is a core layer with high tensile strength, and layer C has little, if any, cling properties.

The invention further comprises a method for
10 fabricating polyolefin films (including the stretch wrap films referenced above) by incorporating a medium density polyethylene or high density polyethylene with the polyolefin in the rotating extruder.

15 Detailed Description of the Invention

The invention comprises a single-sided cling stretch wrap film. In order to achieve the desired single-sided cling properties a co-extruded film structure is utilized. The surface of the film
20 structure of this invention having a cling force is referred to herein as the A surface. The surface opposite the A surface is cling-free. In other words, the cling force of this surface of the film structure to the surface opposite the A surface of a
25 like film is negligible and ideally is not detectable. Further, the surface opposite the A surface is characterized by a slide property when it is in contact with the like layer of a second like film and when there is relative motion between the
30 two surfaces. The coefficient of friction of these

two surfaces is between about 0.2 to about 2.0, and most preferably is less than 1.0, as measured by ASTM 1894.

The film-forming component of the cling-free layer of the film structure of this invention imparts a noncling-slip surface to the extruded film. The film forming system from which this surface is fabricated contains a polyolefin having a MFR less than or equal to ten. (Melt flow ratios, MFR, referred to herein are in accordance with ASTM D-1238). Such polyolefins are most preferably homopolymers of propylene and copolymers of propylene and α -olefins. Homopolymers of ethylene and copolymers of ethylene and a C₃-C₁₀ α -olefin having a density greater than 0.925 g/cc are likewise preferred. Suitable α -olefins for the propylene and ethylene copolymers have three to 10 carbon atoms and are monoolefinic. The amount of α -olefin in the copolymer is generally between about 0.5 to 20, most preferably less than 5, weight percent. The use of such polyolefins in the cling-free layer makes unnecessary the addition of anti-cling additives or "slip additives." The coefficient of friction of the cling-free surface of the film of this invention to the cling-free surface of a second like film structure is less than 2.0 and generally less than 1.0. (Coefficient of friction measurements referenced herein are in accordance with ASTM 1894).

As explained more fully below, the film-forming system of the cling-free surface may further contain a high density polyethylene (HDPE) or medium density polyethylene (MDPE). Generally, between about 10 to
5 about 50 weight percent MDPE or HDPE is preferred. A HDPE has a maximum density greater than or equal to 0.940 g/cc. Such polymers are often copolymers of ethylene with a C₃-C₁₀ α -olefin, such as propylene or butene. Normally the amount of α -olefin is
10 approximately 0-5%, preferably 0-2 percent. Where the density is 0.960 g/cc or greater a homopolymer of ethylene may be used. MDPE is defined as having a minimum density ranging from about .925 to about
15 .940, preferably about .935. MDPE are copolymers of ethylene and at least one of the C₃-C₁₀ olefins recited above. (It is well recognized in the art that the density of the copolymer decreases as the amount of comonomer increases.)

The cling force of the A surface of the film
20 structure of this invention to the A surface of a like film (of identical composition) is between about 150 g to about 400 g. (Cling force measurements referred to herein are in accordance with ASTM D4649 wherein the surfaces of the films
25 are in an unstretched condition.) The A layer for use in the present invention is fabricated from a resin possessing an inherent cling property and/or a cling property resulting from the incorporation of a cling additive. Examples of such resin film-
30 forming compositions are polyolefins such as

polyethylene, atactic polypropylene, copolymers of ethylene and propylene, and polymers obtained from ethylene and/or propylene copolymerized with relatively minor amounts of an ethylenically unsaturated monomer such as a mono-olefin, preferably a C-C mono-olefin, such as butene-1 and isobutylene, acrylic acid, methacrylic acid, esters of acrylic acids, vinyl acetate, styrene and combinations thereof. Preferred is polyethylene, including high and low molecular weight polyethylene, and copolymers of ethylene as set forth above.

Suitable for the cling film portion of the stretch wrap film of the present invention are those resin-forming systems which do not exhibit a fairly high level of cling without the addition of a cling additive such as linear low density polyethylene (LLDPE). LLDPE is defined as having a maximum density ranging from about 0.912 g/cc to about 0.925 g/cc, preferably about 0.917 g/cc. LLDPE, characteristically has a melt flow value (ASTM D 1238 Cond. E) ranging from about 0.3 to about 10.0, preferably about 2.3, and is a copolymer of ethylene with a C₄-C₁₀ olefin, for example, butene-1; 1,3-dimethyl-butene-1; 1,3-dimethyl-pentene-1; hexene-1; 4-methyl-pentene-1; 3-methyl-hexene-1; octene-1; or decene-1. The alpha-olefin is usually between 1 to 20 weight percent of the copolymer. Further, ultra low density polyethylene (ULDPE) and linear medium density polyethylene (LMDPE) is also particularly

preferred. ULDPE is defined as having a maximum density ranging from about 0.890 g/cc to about 0.915 g/cc, preferably about 0.912 g/cc and contains a higher percentage of the C-C olefin. LMDPE has a
5 density between about 0.925 to about 0.940 and likewise is a copolymer of ethylene and a C₃-C₁₀ olefin.

Resins not inherently possessing cling properties can nevertheless be used in this
10 invention by incorporating with the resin a cling additive.

The resin film-forming film of the A layer may contain any known cling agent which will be effective in maintaining the A layer in cling
15 contact with the surface of a cling-free layer of a second like film of like composition. Nonlimiting examples of cling additives include, for example, such tackifiers as polybutene and low molecular weight polyisobutylene, preferably between 200-3000,
20 most preferably 200-300. Other suitable tackifiers include polyterpenes, amorphous polypropylene, ethylene vinyl acetate copolymers, microcrystalline wax, alkali metal sulfosuccinates, and mono- and di-glycerides of fatty acids, such as glycerol
25 monostearate, glycerol monooleate, sorbitan monolaurate, sorbitan monopalmitate, sorbitan monostearate and sorbitan monooleate. Preferably, the tackifier is polybutene. The cling additive can be present in the A layer in any
30 concentration which will permit the A surface to

cling to the cling-free surface of a second like film of like composition or other surfaces. A preferred concentration can range from about 0.1 to 20% by weight of the A layer, most preferably
5 between 0.25 to 6.0 weight percent.

A particularly preferred embodiment of this invention is a co-extruded A/B/C film structure wherein layer B has been bonded through the co-extrusion process to layers A and the cling-free
10 layer, layer C. Layer B is characterized by a high tensile strength and is chiefly responsible for rendering high tensile strength to the A/B/C film structure. This thermoplastic film structure exhibits a machine directional tensile strength
15 between about 4,000 to about 12,000 psi, as measured by ASTM D 882. Generally, the tensile strength is between about 6,000 to about 7,000 psi. The cling force of the A surface of this A/B/C film to the A surface of a like A/B/C film (of identical
20 composition) is between about 150 g to about 400 g. In addition, the cling force of the A surface to the C surface of a like A/B/C film is between about 100 g to about 350 g. The A/B/C film structure of this invention further has a minimum stretch capability
25 of about 200%, and a maximum stretch capability of about 600%, preferably between 250 and 450%, as measured by ASTM D4649 (A1.2.2). Such minimum stretch capability is desired due to the continuous stretching of the film roll caused by the braking
30 tension applied to the roll after the film is laid

about the girth of the pallet platform during overwrapping.

5 The film should have an A to B to C weight ratio of from about 5:90:5 to about 30:40:30, most preferably about 10:80:10. The film will have an overall thickness ranging from about 0.3 mil to about 3.0 mil, preferably 0.8 mil. In general, the thickness of the A layer is between about 0.025 to about 0.9 mils. The thickness of the B layer is 10 between about 0.020 to about 2.7 mils and the thickness of the C layer is between about 0.025 to about 0.9 mils. The A layer is preferably between 5 and 15 weight % of the overall film thickness; the B layer is between 70 and 90% of the overall film 15 thickness; and the C layer is between 5 and 15% of the overall film thickness.

The C layer of this film is fabricated from the polyolefin described above as the "cling-free layer" for the film structure of this invention.

20 The B layer exhibits a minimum machine directional tensile strength value ranging from about 4,000 psi to about 12,000 psi, preferably about 7,000 psi, as measured by ASTM D882. Suitable as the resin film-forming composition for 25 the B layer for use in this invention are polyolefins such as polyethylene and copolymers of ethylene and/or propylene and a minor amount of a C₄-C₁₂ mono-olefinic monomer such as butene-1 and isobutylene. Especially preferred is LLDPE, as 30 defined herein. The B layer is most preferably

chemically distinct from the film-forming resins of layers A and C, i.e. the film-forming resins of layers A and C are not identical to the film-forming resin of layer B. In the most preferred embodiment
5 of the invention the film is fabricated from three chemically distinct resin film-forming systems.

The stretch wrap films of this invention are formed by conventional techniques of coextrusion to assemble the composite structure, such as by the
10 simultaneous coextrusion of resin film-forming layers. The melt temperature for each extruder is independently selected such that the viscosity of the different film components is matched. In such co-extrusion processes, the three extruders should
15 be operating simultaneously to produce the coextruded film. Thus, the output capacity for each of the three extruders should be close to equivalent.

For example, to produce a 10:80:10 (w/w) A/B/C
20 film structure, if the core (center) extruder for layer B is relatively small (1.5 inch diameter, 24:1 L:D) then the satellite extruders for layers A and C must be proportionately smaller. If on the other hand the core extruder is relatively large (6 inch
25 diameter, 30/1 L/D) then the size of the satellite extruders must be increased in order for the film layer ratios to remain relatively constant. In addition, the melt viscosity of all three components must be approximately the same. Generally, the
30 viscosity of the resin forming systems of the

respective layers are matched. For instance in the fabrication of the A/B/C film, layers A and C are matched to the viscosity of the resin film-forming system of layer B. Thus, if the viscosity of the resin in the A or C extruder becomes lower than that of the core layer at any given temperature, then its melt temperature must be reduced to increase its viscosity. If the viscosity of the resin in the A or C extruder becomes higher than that of the resin film-forming system of the B layer, then its melt temperature must be increased to decrease its viscosity. Since each extruder of the film-forming system B operates at a separate melt temperature, the temperature profile of the zones in each extruder will likewise differ.

In preparing the extrudate of the present invention, the resin film-forming systems of the respective layers are fed into the feed hopper of a conventional rotating screw extruder. The resin is melted by working it in the compression zone of the extruder. The molten resin is continuously advanced through the metering zone to the mixing zone of the extruder.

It is readily recognized in the art that the production of thicker extrudates either requires an operator to increase the speed of the extruder or decrease the line speed, i.e. the rate the extrudate is removed from the die. Modern extrusion apparatus naturally have maximum speeds and minimum line speeds that can complicate the process. As

previously stated the viscosity of the resin film-forming system of the layers of the film structures of this invention must be approximately the same during co-extrusion. The melt viscosity of the preferred polyolefin resin film-forming system of the cling-free layer, i.e., homopolypropylene and propylene- α -olefin copolymers, rapidly decreases with an increase in temperature. The addition of between about 10 to about 50 weight percent (based on total weight percent of resin film-forming system) of high density polyethylene or medium density polyethylene to the polyolefin dramatically reduces the extruder speed required to produce the film structure or layer. Most preferably the resin film-forming system comprises approximately 35-40 weight percent of medium or high density polyethylene. In addition, the viscosity of the resin film-forming system containing the medium or high density polyethylene/polyolefin blend is similar to that of the resin film-forming compositions which do not contain medium or high density polyethylene. Thus, medium and high density polyethylene serve as an invaluable processing aid to molten extrudates of polyolefin.

While the use of medium or high density polyolefin with polypropylene is preferably realized in the fabrication of the cling-free layer of the film structure of this invention, it is also within the scope of this invention to provide a single film structure or even a laminate with such composition.

Thus, the use of the medium and high density polyethylene/polyolefin blend is not restricted to the production of the cling-free layer of an A/B/C or A/B film structure but is equally applicable in
5 the production of a single film structure or laminate.

EXAMPLES

General Procedure

In preparing the A/B/C extrudates of the
10 present invention any known prior art technique for coextrusion can be employed. The resin film-forming composition of each layer is fed into the feed hopper of a conventional rotating screw extruder. The extruder screw employed can have approximately a
15 5 inch (1.5 inches for Examples 1-4 and 8-16) diameter and a length to diameter, L/D, ratio of about 30:1. Satellite extruders are used for the coextrusion of the resin film-forming compositions A and C. The satellite extruders comprise a
20 conventional extruder having an extruder screw with about a 2.5 inch (0.75 inches for Examples 1-4 and 8-16) diameter and a L/D ratio of about 30:1. Molten resin from the satellite extruders are fed into the slot film die affixed to the end of the B
25 extruder through an adapter specifically designed to join polymer streams A and C from the satellite extrudates to the molten B polymer stream so that it effectively interfaces with the molten surface of the B layer. These three separate streams are then
30 passed out of the film forming die with a die gap of

approximately of 15 to 20 mil at a melt temperature of approximately 420°F (A layer), 510°F (B layer), and 480°F (C layer).

GLOSSARY

- 5 As used herein, the materials recited in these Examples are commercially available. In the examples the actual material used is indicated by reference to the corresponding glossary number.

16

	<u>MATERIAL</u>	<u>DENSITY</u>	<u>MELT FLOW</u> <u>ASTM D1238</u>	<u>COMMERCIALY</u> <u>AVAILABLE AS</u>	<u>SOURCE</u>
5	1. Polypropylene		12.0	3014	Exxon Chemical Co.
	2. Polypropylene		2.9	5A08	Shell Oil Co.
	3. Propylene/ethylene copolymer		4.0	7C49	Shell Oil Co.
	4. Polypropylene		3.9	4062	Exxon Chemical Co.
	5. Polypropylene		3.0	HGX-030	Phillips Pet. Co.
10	7. Polypropylene		3.0	2104	Soltex, Inc.
	8. Propylene/ α -olefin copolymer		4.0	4207	Soltex, Inc.
	20. LLDPE	0.917	2.3	2047	Dow Chemical Co.
15	21. LMDPE	0.935	2.5	2036A	Dow Chemical Co.
	22. LMDPE	0.926	2.0	2032	Dow Chemical Co.
	23. LLDPE	0.912	3.3	4004	Dow Chemical Co.
	30. Tackifier (52% of polybutene in LLDPE)				Santech Co.
20	35. Styrene-Butadiene Copolymer			KR-10	Phillips Pet. Co.
25	40., 41. Methacrylic acid copolymer (MMA) - a copolymer of ethylene and approximately 20-30 wt.% methacrylic acid, commercially known as XC-102 ⁴⁰ and XC-101 ⁴¹ from Exxon Chemical Company.				
	51. HDPE	0.962	10.0	10062	Dow Chemical Co.

Comparative Example 1

Film 1 has a composition as follows: Layer A
 (15% by weight of total film) is LLDPE²³ with 6%
 tackifier³⁰; Layer B is LLDPE²⁰ (approximately 70% by
 weight of total film); and Layer C (15%) is LLDPE²⁰
 with 0.5% silicon dioxide slip agent. The cling
 properties are presented in Table 1.

35 Comparative Example 2

Film 2 has the same composition as Film 1, except
 that Layer C does not contain silicon dioxide slip
 agent. The cling properties are presented in Table 1.

Comparative Example 3

40 Film 3 has the same composition as Film 1, except
 that Layer C is LMDPE²¹. The cling properties are
 presented in Table 1.

Comparative Example 3

Film 3 has the same composition as Film 1, except that Layer C is LMDPE²¹. The cling properties are presented in Table 1.

5 Example 4

Film 4 has the same composition as Film 1, except that Layer C is a polypropylene homopolymer².

TABLE I

10

			<u>CLING (g)</u>	
	<u>Ex.</u>	<u>A/A</u>	<u>C/C</u>	
	Comp. Ex. 1	325	25	
	Comp. Ex. 2	230	170	
15	Comp. Ex. 3	270	70	
	4	325	(NA) *	

* The C/C cling value could not be evaluated utilizing the standard cling test. However, the coefficient of friction (ASTM D-1894) was determined to be 0.5.

Table 1 is illustrative of some of various approaches taken in the past concerning the non-cling surface of single-sided cling film. Example 2 shows that LLDPE is not a preferred material due to its substantial cling to itself. Example 1 shows that addition of non-cling additives provide enhancement of the desired non-cling property. Example 3 shows that an increase in the density has limited enhancement of non-cling properties. Example 4, on the other hand,

shows true non-cling properties. The standard test for cling (ASTM D4649) cannot be used to quantitate the cling properties of this material. As a result a more sensitive test--the coefficient of friction (ASTM D1894) was employed.

Example 5-6 and Comparative Example 7

Resin film-forming compositions were prepared as extrudates in accordance with the General Procedure above. Percentages are weight percentages. The speed of the extruder is indicated. Table II reports the cling data ASTM D4649, Standard Guide for Selection of Stretch Wrap Materials:

		<u>EX 5</u>	<u>EX 6</u>	<u>COMP EX 7</u>
5	A layer, MMA ⁴⁰ , wt%	10	10	10
	B layer, LLDPE ²⁰ , wt%	80	80	80
10	C layer, Polypropylene ⁴ wt%	10	5	0
	C layer, HDPE, wt%	0	5	10
15	Extruder A rpm	35.8	30	30
	Extruder B rpm	47.8	30	30
20	Extruder C rpm	111.9	30	30
25	Cast Roll, Ft. per min.	746	311	380

30 These examples demonstrate that productivity in
the fabrication of the film structures for a given
thickness is increased by employing high density
polyethylene⁵¹ as a processing aid. Example 5
illustrates that the C extruder requires a higher rpm
35 output when 100% polypropylene is used in the
fabrication of a C layer comprising 10% thickness.
The maximum output capacity for extruders A, B, C was
125 rpm. The productivity improvement potential for
extruder C of Example 6 is 4.16 (125 rpm ÷ 30 rpm).
40 The maximum operation potential is 1296 feet per
minute (fpm) (311 fpm x 4.16). In contrast the
productivity improvement potential for extruder C of

20

Example 5 is 1.12 (125 rpm ÷ 111.9 rpm). The maximum operation potential is 833.3 fpm (746 fpm x 1.12).

The productivity improvement is approximately 56%.

Less rpm for the C extruder is required when the

5 processing aid HDPE is used.

TABLE II

10		<u>% STRETCH</u>		
	<u>EXAMPLE</u>	<u>100</u>	<u>150</u>	<u>200</u>
	5	Fair	Fair	Fair
	6	Fair	Fair	Fair
15	7	Fair	Poor	None

Examples 8-16

The films were prepared in accordance with the procedures of Exs. 5-6 and Comparative Example 7 above. 10% of the film comprised layers A and C and 80% layer B. Respective cling forces are compiled in Table III. Data for dynamic coefficient of friction, ASTM D-1894, is compiled in Table IV.

25

		<u>A LAYER</u>	<u>B LAYER</u>	<u>C LAYER</u>
5	Comp. Ex. 8	Methacrylic Acid Copolymer ⁴¹	LLDPE ²⁰	LLDPE ²¹
	Comp. Ex. 9	Methacrylic Acid Copolymer ⁴⁰	LLDPE ²⁰	Styrene- butadiene ³⁵
10	Ex. 10	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ⁷
	Ex. 11	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ⁸
15	Ex. 12	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ²
	Ex. 13	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ³
20	Comp. Ex. 14	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ¹
	Ex. 15	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ⁴
25	Ex. 16	94% LLDPE ²³ 6% polybutene ³⁰	LLDPE ²⁰	Polypropylene ⁵
30				

TABLE III

	<u>EX.</u>	<u>A/A</u>	<u>A/C</u>	<u>C/C</u>
35	8	364±96	225±42	NA
	9	35	40	NA
	10	280±51	143±39	NA
	11	176±28	157±16	NA
40	12	324±72	198±66	NA
	13	513±55	NA	NA
	14	347±50	191±28	NA
	15	217±11	124±24	NA
45	16	442±20	192±81	NA

TABLE IV

	<u>EX.</u>	
50	8	>2.0
	9	>2.0
	10	0.55

TABLE IV

	<u>EX.</u>	
	8	>2.0
5	9	>2.0
	10	0.55
	11	0.59
	12	0.49
	13	0.70
10	14	>2.0
	15	0.65
	16	0.51

Example 17

15 The number of breaks a 1500 foot roll of 20
inches wide of the film structure prepared in
Example 6 having a total thickness of 0.8 mils was
determined by using a pallet wrapper commercially
available from Lamtech, Inc. of Louisville, Kentucky.

20 The film was prestretched 225% by making the second
prestretch roller run $2\frac{1}{4}$ times the rpm of the first
roller. Minimal relaxation was permitted. The
number of breaks in every 1500 feet of film was
determined, ASTM 4649.

25		<u>Example*</u>
		<u>17</u>
	% stretch	210
	(measured	
30	on pallet)	
	width of	20
	roll/inches	
35	No. of breaks	0
	* 4 rolls tested	

40 The invention has been described with reference
to its preferred embodiments. From this description,

23

a person of ordinary skill in the art may appreciate changes that could be made in the invention which do not depart from the scope and spirit of the invention as described above and claimed hereafter.

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WHAT IS CLAIMED IS:

- 1 1. A stretch wrap thermoplastic A/B/C film
2 having minimum stretch capability of 200% comprising:
3 an A surface having a cling force to the C
4 surface of a like A/B/C film between about 100 to
5 about 350 g;
6 a B layer having a tensile strength between
7 about 4,000 to about 12,000 psi; and
8 a C layer having a cling force in a non-
9 stretched condition to the C surface of a second like
10 non-stretched A/B/C film according to ASTM D4649 of
11 approximately zero wherein said C surface is
12 fabricated from a film forming system free of a slip
13 additive and comprising a polyolefin having a melt
14 flow rate, in accordance with ASTM D-1238, less than
15 10.0.
- 1 2. The stretch wrap film of claim 1, wherein the
2 cling force of the A surface to the A surface of a
3 like A/B/C film as measured according to ASTM D4649
4 is between about 150 to about 400 g.
- 1 3. The stretch wrap film of claim 1, wherein the
2 coefficient of friction of the C surface of said film
3 to the C surface of a second like A/B/C film as
4 measured according to ASTM 1894 less than 2.0.
- 1 4. The stretch wrap film of claim 3, wherein
2 said coefficient of friction is less than 1.0.

1 5. A stretch wrap thermoplastic film comprising:
2 an A surface having cling force to the C
3 surface of a like A/B/C film;
4 a B layer having a tensile strength between
5 about 4,000 to about 12,000 psi; and
6 a C layer having a substantially non-cling
7 surface fabricated from a resin film forming system
8 consisting of a polyolefin having a MFR less than or
9 equal to 10.0.

1 6. The stretch wrap film of claim 5, wherein the
2 coefficient of friction of the C surface of said film
3 to the C surface of a second like A/B/C film as
4 measured according to ASTM 1894 is less than 2.0.

1 7. The stretch wrap film of claim 6, wherein
2 said coefficient of friction is less than 1.0.

1 8. The stretch wrap film of claim 6 wherein the
2 tensile strength of the B layer is between about
3 6,000 to about 7,000 psi.

1 9. The stretch wrap film of claim 5, wherein the
2 A:B:C weight ratio is between from about 5:90:5 to
3 about 30:40:30.

1 10. The stretch wrap film of claim 9, wherein the
2 A:B:C ratio is approximately 10:80:10.

1 11. The stretch wrap film of claim 5, wherein
2 said B layer is fabricated from a polyolefin selected
3 from the group consisting of polyethylene and a
4 copolymer selected from ethylene, propylene and a C₄-
5 C₁₂ mono-olefin.

1 12. The stretch wrap film of claim 5, wherein
2 said polyolefin is selected from the group consisting
3 of (i) polyethylene (ii) polypropylene (iii) a
4 copolymer of ethylene and an α -olefin having a
5 density greater than 0.925, and (iv) a copolymer of
6 propylene and α -olefin.

1 13. The stretch wrap film of claim 12, wherein
2 the film-forming system further comprises high
3 density polyethylene or medium density polyethylene.

1 14. The stretch wrap film of claim 13, wherein
2 between about 10 to about 50 weight percent of said
3 resin film-forming system comprises high density
4 polyethylene.

1 15. The stretch wrap film of claim 1, wherein
2 said polyolefin is selected from the group consisting
3 of (i) polypropylene (ii) polyethylene (iii) a
4 copolymer of ethylene and an α -olefin having a
5 density greater than 0.925 and (iv) a copolymer of
6 propylene and an α -olefin.

1 16. The stretch wrap film of claim 15, wherein
2 the resin film-forming system further comprises
3 medium density polyethylene or high density
4 polyethylene.

1 17. The stretch wrap film of claim 16, wherein
2 between about 10 to about 50 weight percent of said
3 resin film-forming system comprises high density
4 polyethylene.

1 18. A stretch wrap thermoplastic film which
2 comprises a surface having a cling property and an
3 opposite surface having substantially no cling
4 property and further wherein the cling-free surface
5 is fabricated from a film-forming system containing a
6 resin having an MFR less than or equal to 10.0
7 wherein said resin is selected from the group
8 consisting of (i) polyethylene (ii) polypropylene
9 (iii) a copolymer of ethylene and an α -olefin having
10 a density greater than 0.925 and (iv) a copolymer of
11 propylene and a α -olefin.

1 19. The stretch wrap film of claim 18 wherein
2 said resin film-forming system further comprises
3 between about 10 to about 50 weight percent of a high
4 density polyethylene or medium density polyethylene.

1 20. The stretch film of claim 18, wherein said
2 film is a A/B/C layer film structure.

1 21. In a process of preparing a film from a
2 polyolefin selected from the group consisting of (i)
3 polypropylene (ii) polyethylene (iii) a copolymer of
4 ethylene and an α -olefin having a density greater
5 than 0.925 and (iv) a copolymer of propylene and an
6 α -olefin in a rotating screw extruder wherein said
7 polyolefin is fed into the hopper of said extruder,
8 melting the polyolefin by working it in the
9 compression zone of the extruder, continuously
10 advancing the molten polyolefin through the metering
11 zone to the mixing zone of the extruder, the
12 improvement comprising feeding to said extruder with
13 said polyolefin between about 10 to about 50 weight
14 percent high density polyethylene or medium density
15 polyethylene.

1 22. The process of claim 21, wherein said resin
2 film-forming system comprises approximately 35-40
3 weight percent high density polyethylene.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US91/00162

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all.) According to International Patent Classification (IPC) or to both National Classification and IPC IPC(5): B32B 27/08 U.S. CL. 428/516, 349						
II. FIELDS SEARCHED <div style="text-align: center; font-size: small;">Minimum Documentation Searched?</div> <table style="width: 100%; border: none;"> <tr> <td style="width: 30%; border: none;">Classification System</td> <td style="border: none;">Classification Symbols</td> </tr> <tr> <td style="border: none; vertical-align: top;">U.S.</td> <td style="border: none; vertical-align: top;">428/516, 349, 212, 218; 156/244.11.</td> </tr> </table> <div style="text-align: center; font-size: x-small; margin-top: 10px;">Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched</div>			Classification System	Classification Symbols	U.S.	428/516, 349, 212, 218; 156/244.11.
Classification System	Classification Symbols					
U.S.	428/516, 349, 212, 218; 156/244.11.					
III. DOCUMENTS CONSIDERED TO BE RELEVANT						
Category *	Citation of Document, ¹ with indication, where appropriate, of the relevant passages ²	Relevant to Claim No. ³				
A	US, A, 4,518,654 (EICHBAUER) 21 MAY 1985 (See Entire Document)	1-21				
X	US, A, 4,671,987 (KNOTT ET AL) 09 JUNE 1987 (See Example)	1-21				
X	US, A, 4,820,589 (DOBRESKI ET AL) 11 APRIL 1989 (See Column 2, lines 28-46)	1, 3, 4, 15, 18				
<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 48%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>						
IV. CERTIFICATION						
Date of the Actual Completion of the International Search <div style="text-align: center; font-size: large;">13 MARCH 1991</div>		Date of Mailing of this International Search Report <div style="text-align: center; font-size: large;">01 APR 1991</div>				
International Searching Authority <div style="text-align: center; font-size: large;">ISA/US</div>		Signature of Authorized Officer <div style="text-align: center;"> E. Rollins Buffalo </div>				